Tarrant Regional Water District (TRWD) Unidesk® and VMware View™ SMB Reference Implementation

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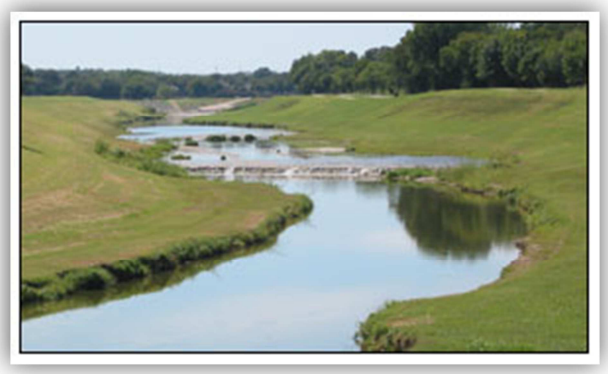
Introduction

This paper outlines the successful design and implementation of a Virtual Desktop Infrastructure (VDI) at Tarrant Regional Water District (TRWD) of Fort Worth, Texas, USA by Sequel Data Systems. The VDI solution – ideal for Small and Mid-Sized Businesses (SMB) – is based on Unidesk® virtual desktop provisioning and management software and VMware View™ desktop virtualization software.

Organization Overview

As one of the largest raw water suppliers in the state of Texas, TRWD provides water to more than 1.7 million people in the North Central Texas area. Its mission over the past 80 years has been to provide quality water to its customers, implement vital flood control measures, and create recreational opportunities for Tarrant County residents and communities.



Led by a publicly elected five-member board, the Water District owns and operates four major reservoirs including Lake Bridgeport, Eagle Mountain Lake and the Cedar Creek and Richland-Chambers Reservoirs. TRWD has also constructed more than 150 miles of water pipelines, 27 miles of floodway levees, more than 40 miles of Trinity River Trails and a 260 acre wetland water reuse project designed to increase future water supplies for the area.

User and Desktop Requirements

TRWD employs approximately 400 full-time people, many of whom are engineers and other types of knowledge workers who require a diverse set of applications, including applications installed by the end users themselves, to get their jobs done. Up to 100 consultants may intermittently join the TRWD staff to work on specific pipeline projects or to assist with flood response, adding to the number of desktops that must be provisioned and managed by TRWD's lean IT staff.

VDI was a natural fit for TRWD for several reasons:

- Full-time workers need 24X7 access to desktops from a variety of endpoints, including work PCs, home PCs, thin clients, and mobile devices;
- Consultants need access to TRWD desktops and applications from remote offices and locations;
- IT needs an easy way to dynamically provision and decommission desktops as consultants come and go;
- IT needs an easy way to manage desktops without having to spend time physically visiting PCs.

VDI Architecture Challenges

Although VDI is well-suited to address TRWD's user and desktop requirements, designing the right architecture was not without its challenges. TRWD became an early adopter of VDI, and has now been using it for several years. As the market for VDI solutions evolved, Sequel Data worked with TRWD to implement a solution that scales to the entire organization, and is successful from both IT cost and manageability perspectives, as well as end user flexibility and user experience perspectives.

The VDI challenges that TRWD faced are typical of most SMBs:

- Some of the applications used by TRWD staff are graphics and CPU-intensive, so virtual desktop performance needs to be as good as or better than a traditional PC;
- Persistent desktops that retain user-installed applications are needed to satisfy the desktop customization requirements of TRWD's engineers and consultants, and offload TRWD's small IT staff from having to deliver every application;
- Storage and image management costs need to be kept low to help maximize TRWD's small IT budget;
- Everyone on the IT staff is responsible for more than just desktops, so they need a simple way to patch Windows and package and deliver the mix of applications required by TRWD end users.

TRWD leveraged a VDI implementation architecture created with an eye toward addressing all of these challenges. The solution includes Servers, Networking, Storage, and related software components. The basis for the solution is the combination of Unidesk virtual desktop provisioning and application management software and VMware View desktop virtualization software.

This remainder of this paper focuses on the actual VDI implementation that will scale up to 600 users, and the integration of HP blade servers, HP storage, VMware vSphere, Unidesk, and VMware View that makes it possible.

VDI Solution Design

As a trusted advisor, Sequel Data Systems was tasked to help TRWD design a virtual desktop environment that would initially support 100 desktops, and enable TRWD to migrate an additional 500 users over the course of the next 12 months.

TRWD was determined to give its end users a virtual desktop experience that was better than a PC from an access perspective, and at least equal to a PC from performance and personalization perspectives. On the IT operations side, TRWD expected VDI to reduce the amount of time its administrators spent patching, updating, and repairing desktops, and packaging and delivering applications.

These requirements led TRWD's IT team to select Unidesk and VMware View to provide the simple desktop management, ubiquitous desktop access, and high performance, highly customizable end user experience required to make the VDI project a success. HP server, storage, and networking components – already in place to support TRWD's VMware-based server virtualization initiative – would be leveraged for the new virtual desktops.

The VDI solution design for TRWD is shown in Figure 1 below.

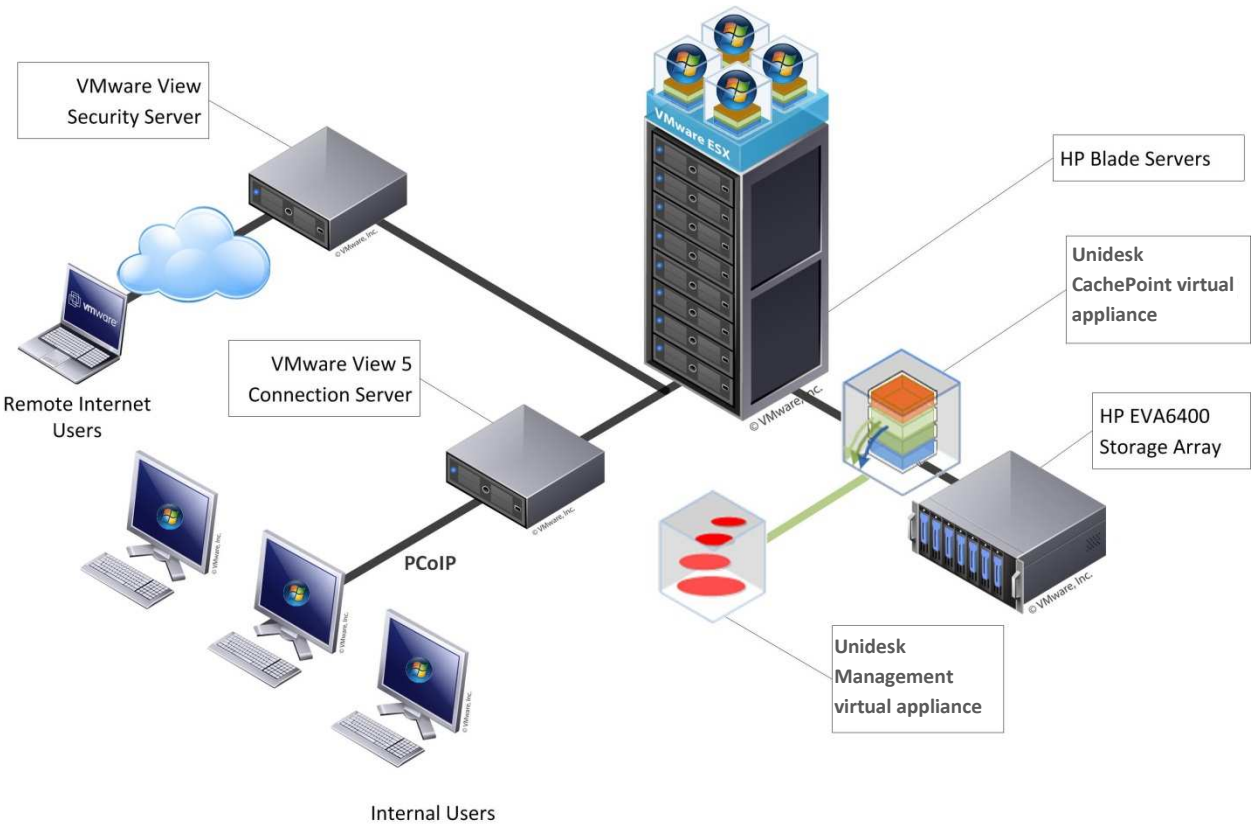


Figure 1: An overview of TRWD's VDI solution

Eight HP BL460C blade servers were implemented to support 500 virtual desktops, with a density of ~62 desktops per host. These eight servers provide capacity for both growth and failover.

A single HP EVA 6400 provides a highly available, centralized storage backend for all virtual desktops in the TRWD environment.

Unidesk desktop layering technology provides:

- Operating system image management – 1 gold shared by all persistent desktops to simplify gold image patching and provisioning and reduce storage;
- Application delivery – 1 set of application layers shared by different desktops to simplify application packaging and patching and reduce storage;
- Personalization – retain user-installed applications and all other customizations.

VMware vSphere virtual infrastructure and VMware View desktop virtualization software provide:

- Hypervisor technology to host the virtual desktops;
- Brokering and high-speed PCoIP protocol to ensure a high-performance user experience;
- Broad client support to enable access to desktops from any endpoint device;
- Security servers located in the DMZ to provide secure remote access to the VDI environments.

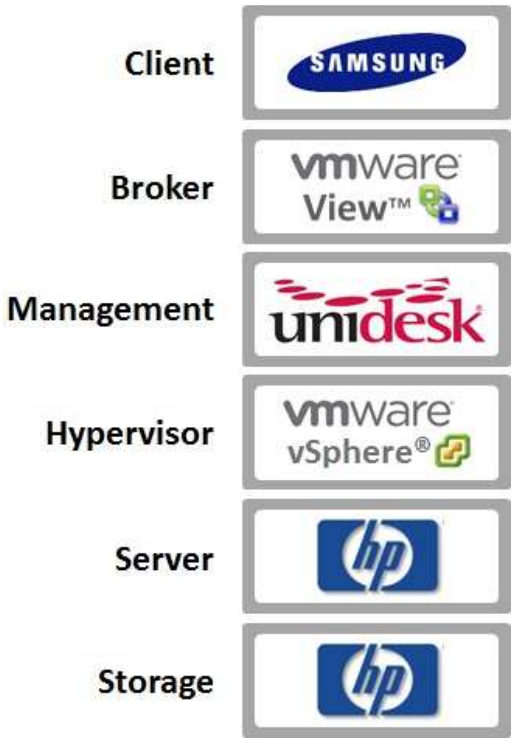


Figure 2: TRWD's VDI solution "stack"

Technical Details

While every VDI environment is unique with regard to desktop workloads, user connectivity, and storage requirements, TRWD's implementation is representative of an environment that can be expanded to support hundreds of users both within the trusted network and in remote access scenarios.

Servers

- Eight HP BL460C G6 Blade servers
  - Dual Intel Xeon Nehalem Quad-Core 2.93 GHz CPUs
  - 96 GBs RAM
  - 8Gb/s Fibre Channel HBAs

Storage

- HP EVA 6400 Enterprise Virtual Storage (EVA) Array
  - 132 disks all in one disk group
  - Disks configured in 14 VRAID5 sets with 500GB LUNs for VMware VMDKs, and 3 VRAID1 sets for Unidesk CachePoint virtual appliances

Software

- Virtual Infrastructure Software
  - VMware vCenter for management
  - VMware vSphere 5 /ESXi as the host hypervisor
- Desktop Connectivity/Brokering Software
  - VMware View 5 Premier
- Desktop Management/Provisioning/Application Delivery/Personalization Software
  - Unidesk 1.5

Thin Clients

- Teradici thin and zero clients, including Wyse P20 and Samsung NC 190, 220 and 240 (19, 22 and 24 inch all-in-one monitors reduce the amount of cabling needed at each desk). Zero clients are used where possible to reduce power consumption.
- Older PCs that would have been refreshed are being repurposed as thin clients using Windows 7 Thin OS and the VMware View 5 client.

Networking

- The HP blade chassis is deployed with redundant HP Virtual Connect switches to connect them to the rest of the physical network via redundant 10Gb fiber links.
- The network core consists of two redundant Juniper Virtual Chassis, with each chassis consisting of 5 stacked 42-port switches, each with redundant routing engines.
- Gigabit speed with PoE is available to all users at the primary facility.
- 100Mb is available to other buildings at the primary campus.
- WAN connectivity to most other sites is made up of a 45Mb Microwave radio network with a 3Mb MPLS backup.

Hardware Configuration

The VDI hardware components described in the previous section – HP blade servers, networking equipment, and storage – are shared by TRWD's desktop and server virtualization programs. This sharing of infrastructure has enabled the IT project team to leverage existing investments and reduce overall project costs.

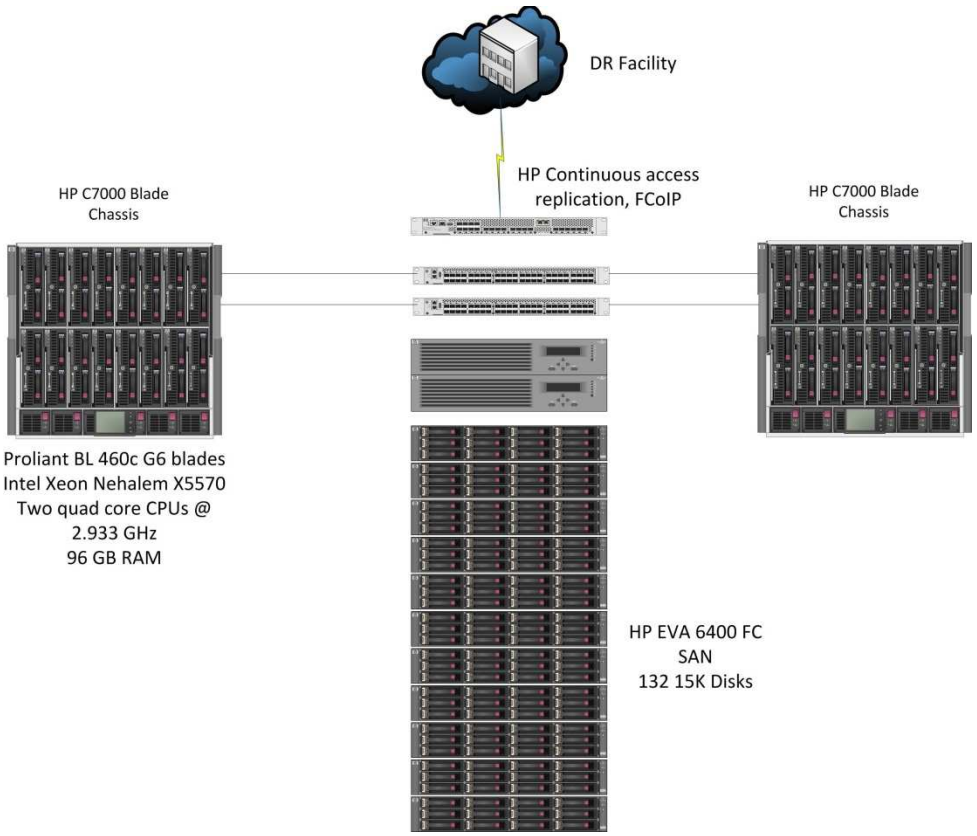

DR Facility
HP Continuous access replication, FCoIP
HP C7000 Blade Chassis
HP C7000 Blade Chassis
Proliant BL 460c G6 blades
Intel Xeon Nehalem X5570
Two quad core CPUs @ 2.933 GHz
96 GB RAM
HP EVA 6400 FC SAN
132 15K Disks

Figure 3: TRWD's VDI hardware configuration

Software Configuration

The VDI software components at TRWD consist of a single VMware vCenter environment, redundant VMware View Connection Servers, eight VMware vSphere servers, a single Unidesk Management Virtual Appliance, and nine Unidesk CachePoint Virtual Appliances.

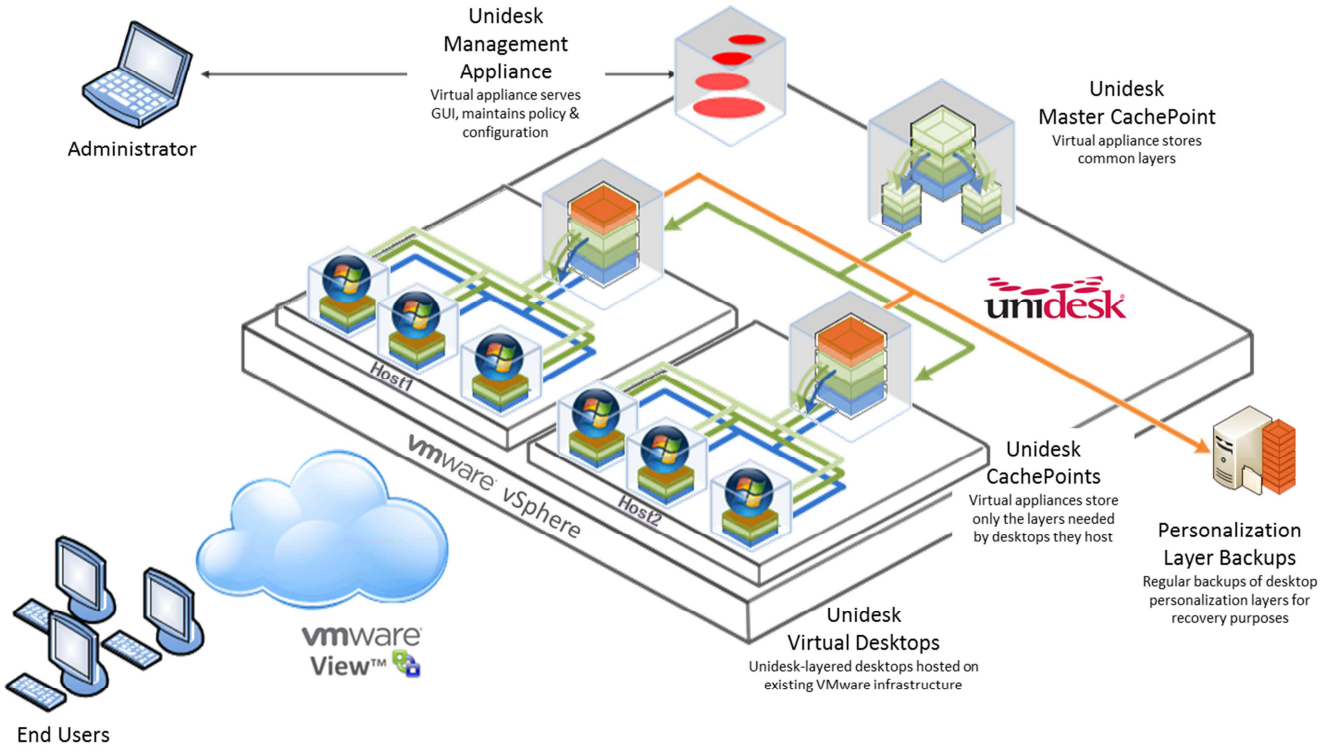


Figure 4: TRWD's VDI software configuration

Desktop Provisioning

Desktop configurations were mapped to Unidesk Desktop Templates, enabling knowledge worker desktops to be quickly provisioned from the same Microsoft Windows 7 gold image and different combinations of applications.

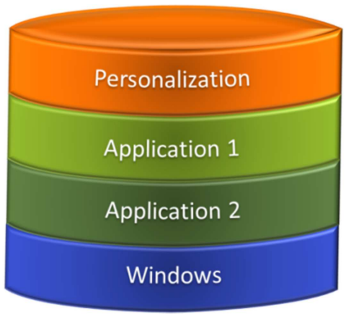


Figure 5: Unidesk layered desktops combine the benefits of stateless, non-persistent and stateful, persistent virtual desktops

The Windows 7 gold image layer, corporate applications, and departmental applications are created by IT as stackable "layers." These layers are non-persistent, and can be patched or updated by at any time.

While Unidesk templates are TRWD's preferred method of provisioning desktops, a process was also developed that allows for "one-off" desktop modifications, where application layers can be added as needed. "A la carte" desktop provisioning is also easy with Unidesk layers.

Application Delivery

To simplify the delivery and patching of the numerous applications required by the TRWD workforce, all corporate and departmental applications were packaged separately as Unidesk layers. TRWD's IT staff can now update all desktops just by patching or updating a single layer once.

7zip	Go To Meeting	Photoshop CS5
Adobe Acrobat	Google Chrome	Microsoft SharePoint Designer 2010
Adobe Reader	Google Earth	Microsoft Silverlight
ArcGIS 10	HECRAS	Microsoft SQL Server Management Studio 2008
Camtasia	HydroDesktop	Microsoft Visio
Commvault Outook Plugin	Java	Orbit Downloader
CoreFTP	KeePass 2.17	Powershell Plus
Dameware	Lawson Security Administrator	Total Commander
Dropbox	Live Messenger	Trimble
DWG TrueView	Mozilla Firefox	VLC Player
EMC Tools	Nitro PDF 7	VMware Management tools
EPANET	Numara Track-It	VMware View Agent 5
Evernote	Microsoft Office 2007	VMware vSphere 5
GateOpsLogger	Microsoft Office 2010	
General Layers	Microsoft Project Professional 2010	

Figure 6: Corporate and departmental applications layered by TRWD

Figure 7: TRWD's Unidesk layers, as captured from the Unidesk Management Console

Applications that are layered with Unidesk technology do not require any special skill or knowledge of the packaging tools. The Unidesk applications seen above are simply installed as you would on a traditional physical PC. After the administrator runs a simple wizard, Unidesk automatically configures a virtual desktop with the desired Windows OS gold image and any prerequisite applications. All that's left for the administrator to do is to install the app.

This method of application packaging reduces the complexity in TRWD's VDI environment, minimizes the amount of training for the IT staff, and keeps the number of gold images down to 1 for the production desktops, making patching and updating Windows much easier.

Personalization and User-Installed Applications

Persistent desktops that retain user-installed applications are needed to satisfy the desktop customization requirements of TRWD's engineers and consultants, and offload TRWD's small IT staff from having to deliver every application. With Unidesk layers, each desktop has its own Personalization layer that sustains all user customizations, including user-installed applications. The Personalization layers are persistent, and are dynamically composited on top of the non-persistent, IT-created layers. TRWD IT staff can patch and update the Windows 7 gold image layer and any of the IT-packaged application layers as often as needed without losing any of the customizations in each user's Personalization layer.

Pool Configuration

Virtual desktop pools in the TRWD environment were created to support both persistent and non-persistent desktops using one of two VMware View pool configurations:

- **Dedicated Pools.** In this configuration, each user is assigned a persistent desktop that is created by Unidesk layering technology and automatically added by Unidesk to VMware View dedicated pools. Dedicated pools are used in cases where a user requires retention of desktop changes and customizations. The user always returns to the same virtual desktop at each login. Users can personalize their desktops, install applications, and store data, and all customizations are retained in the Unidesk personalization layer. Unidesk automatically takes snapshots of this layer so TRWD service desk staff can quickly undo (repair) any damage caused by user customizations. Unidesk enables persistent desktops to be as storage-efficient as non-persistent desktops by sharing a single layer of Windows and corporate applications across many desktops.
- **Floating Pools.** In this configuration, the virtual desktop is non-persistent, meaning it is refreshed after each use and all user customizations are destroyed. Users do not always login to the same virtual machine each time. TRWD uses this for highly controlled use cases such as computer labs and kiosks where IT has loaded each desktop with all of the necessary applications, and folder redirection using the VMware User Data Disk (UDD) is used to access data on mapped drives.

VMware View PCoIP

TRWD uses the display protocol that is now the most common way to access virtual desktops in VMware View and Unidesk environments: VMware's PC-over-IP (PCoIP) protocol. PCoIP delivers an end user experience equal to that of a physical PC. As a starting point, to maximize use of available network bandwidth and enhance each user's experience, IT organizations should follow the recommendations in the VMware View Windows 7 Deployment Guide.

Other VMware View Components

The TRWD VDI design leverages numerous VMware View components. Below is an overview of each of the components used to support TRWD's users:

- VMware View Connection Server: The View Connection Server is a full-featured connection broker. It is the key element that directs traffic within the architecture as a whole. This is the component that provides access to the desktop from the end user client device.
- VMware View Security Server: Outside the corporate firewall, in a DMZ, the View Connection Server can be installed and configured as a security server. Security servers in the DMZ communicate with View Connection Servers inside the corporate firewall. Security servers offer a subset of functionality and are not required to be in an Active Directory domain.
- VMware View Administrator: This Web-based application allows administrators to configure View Connection Server, control user authentication, and troubleshoot end user issues. When a

View Connection Server instance is installed, the View Administrator application is also installed. This application allows administrators to manage View Connection Server instances from anywhere without having to install an application on a local computer.

- VMware View Agent: A View Agent is installed on all virtual machines, physical systems, and Terminal Service servers that are used as sources for View desktops. It is often delivered as a Unidesk layer. This agent communicates with the View Client to provide features such as connection monitoring, virtual printing, and access to locally connected USB devices. The agent can be installed with an option for single sign-on, in which case users are prompted to log in when they connect to View Connection Server, and are not prompted a second time to connect to a virtual desktop.
- VMware View Client: The client software for accessing View desktops runs either on a Windows or Mac PC as a native application, or on a thin client with the View Client for Linux. After logging in, users select from a list of virtual desktops that they are authorized to use. Authorization can require Active Directory credentials, a UPN, a smart card PIN, or an RSA SecurID token.

- VMware vCenter Server: This service acts as a central administrator for VMware vSphere servers that are connected on a network. VMware vCenter™ Server, formerly called VMware VirtualCenter, provides the central point for configuring, provisioning, and managing virtual machines in the datacenter. Unidesk uses vCenter APIs to create, configure, and destroy virtual machines.

Bill of Materials

Leveraging Sequel Data Systems' technology partnerships with HP, Samsung, Unidesk, VMware, and Wyse, an end-to-end solution was provided that met TRWD's VDI objectives. The following tables represent the overall bill of materials used in the TRWD VDI project.

Hardware

Qty	Part Number	Description
1	507019-B21	HP BLc7000 CTO 3 IN LCD ROHS Encl
11	507864-B21	HP BL460c G6 CTO Blade
11	507791-L21	HP X5570 BL460c G6 FIO Kit
11	507791-B21	HP X5570 BL460c G6 Kit
88	500662-B21	HP 8GB 2Rx4 PC3-10600R-9 Kit
22	418371-B21	HP 72GB 3G SAS 15K 2.5in DP ENT HDD
11	416585-B21	HP BLc NC325m NIC Adapter Option Kit
11	403619-B21	HP BLc QLogic QMH2462 FC HBA Opt Kit
6	399593-B22	HP BLc 1/10Gb VC-Enet Module Opt Kit
2	466482-B21	HP BLc VC-FC 8Gb 24-Port Opt Kit
6	499243-B21	HP 2400W High Efficiency Power Supply
6	412140-B21	HP BLc Encl Single Fan Option
1	456204-B21	HP BLc7000 DDR2 Encl Mgmt Option
1	413379-B21	HP BLc7000 1 PH FIO Power Module Opt
1	417688-B23	HP c-Class All FIO 16 Icm 1yr 24x7 Lic
1	HA110A3 4YN	HP ICE-BL 16-Svr SW Support
1	HA110A3 7FX	c7000 Enclosure HW Supp
11	HA110A3 7XE	BL4xxc Svr Bld HW Support
2	T9094AAE	HP VCEM BL-c7000 Encl E-LTU
2	HA110A3 7XB	HP VCEM BL-c7000 SW Support
1	507019-B21	HP BLc7000 CTO 3 IN LCD ROHS Encl
1	507864-B21	HP BL460c G6 CTO Blade
1	507791-L21	HP X5570 BL460c G6 FIO Kit
1	507791-B21	HP X5570 BL460c G6 Kit
8	500662-B21	HP 8GB 2Rx4 PC3-10600R-9 Kit
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6	499243-B21	HP 2400W High Efficiency Power Supply
6	412140-B21	HP BLc Encl Single Fan Option
1	456204-B21	HP BLc7000 DDR2 Encl Mgmt Option

1	413379-B21	HP BLc7000 1 PH FIO Power Module Opt
1	417688-B23	HP c-Class All FIO 16 Icm 1yr 24x7 Lic
1	HA110A3 4YN	HP ICE-BL 16-Svr SW Support
1	HA110A3 7FX	c7000 Enclosure HW Supp
1	HA110A3 7XE	BL4xxc Svr Bld HW Support
1	AF002A	HP Universal Rack 10642 G2 Shock Rack
1	AF002A 001	Factory Express Base Racking
1	AJ757A	HP EVA6400 for Multi Product Rack
2	AG638B	HP M6412-A Fibre Channel Drive Enclosure
18	AG803B	HP EVA M6412A 450GB 15K FC Drive
7	AG638B	HP M6412-A Fibre Channel Drive Enclosure
70	AG803B	HP EVA M6412A 450GB 15K FC Drive
2	252663-D72	HP 24A High Voltage US/JP Modular PDU
1	AF054A	HP 10642 G2 Sidepanel Kit
1	248929-B21	HP Rack 10000 Series Carbon Baying Kit
1	T5494D	HP CV EVA 9.1 Rep Sol Mgr 5.0 Media Kit
1	TA646A	HP Command View EVA6400 Unlimited LTU
1	TA655A	HP Business Copy EVA6400 SW Unlim LTU
1	TA668A	HP Continuous Access EVA6400 Unlim LTU
88	HA110A3 13J	EVA 450-1TB HDD HW Supp
1	HA110A3 4R2	EVA 6400 Command View EVA Unlim LTU Supp
1	HA110A3 4RR	EVA 6400 CA EVA SW Unlimited LTU Supp
1	HA110A3 4RT	EVA 6400 BC EVA Software Unlim LTU Supp
1	HA110A3 9DP	EVA 6400 Array Support
9	HA110A3 9DS	EVA M6412A FC Drive Enclosure Support
4	AJ836A	HP 5m Multi-mode OM3 LC/LC FC Cable
4	T5519A	HP 8/40 SAN Switch 8Gb 8-port Upgr LTU
2	AM869A	HP 8/40 Base 24-ports Enabled SAN Switch
2	HA110A3 9LK	HP B-Series 8/40 SAN Switch Support
48	AJ836A	HP 5m Multi-mode OM3 LC/LC FC Cable
48	AJ716A	HP 8Gb Shortwave B-series FC SFP+ 1 Pack
2	TA750A	HP 1606 Extsn SAN Swtch Intg Routing LTU
2	AP862A	HP 1606 Extension SAN Base Switch
4	AJ835A	HP 2m Multi-mode OM3 LC/LC FC Cable
4	AJ715A	HP 4Gb Short Wave B-series FC SFP 1 Pack
8	AJ716A	HP 8Gb Shortwave B-series FC SFP+ 1 Pack
6	313458-B21	HP B-ser 32-64 Extd Fab SW LTU
6	HA110A3 4DS	Storage SW Low 4DS Support
2	HA110A3 4VY	1606 Base Ext Switch 6 Ports Supp
2	HA110A3 4W3	1606 Switch Integrated Routing Supp
1	T5360A	HP Cont Access EVA6K Ser Unlimited LTU

Software

Qty	Part Number	Description
3	UN-C-P100	Unidesk virtual desktop management 100 Pack, including unlimited desktop CachePoints for single image Windows OS management, application packaging and delivery, storage optimization, and user personalization
3	UN-C-S100	Unidesk Complete Care support 100 Pack for 1 year
20	VS4-ENT-PL-GOV	VMware vSphere 4 Enterprise Plus for 1 processor (Max 12 cores per processor)
20	VS4-ENT-PL-3P-SSS-GOV	Platinum Support/Subscription for VMware vSphere Enterprise Plus for 1 processor for 3 year Vmware
1	VCS-STD-GOV	VMware vCenter Server 4 Standard for vSphere (Includes Orchestrator and Linked Mode)
1	VCS-STD-3P-SSS-GOV	Platinum Support/Subscription for vCenter Server 4 Standard for 3 years Vmware
34	VC-SRM4-GOV	VMware vCenter Site Recovery Manager 4 for 1 processor
34	VC-SRM4-3P-SSS-GOV	Platinum Support/Subscription for VMware vCenter Site Recovery Manager 4 for 3 years
4	VS4-ENT-ENT-PL-UG-PROMO-GOV	Upgrade:VMware vSphere Enterprise to vSphere Enterprise Plus for 1 Processor
4	VS4-ENT-PL-2M-PSSS-GOV	Platinum Support/Subscription for VMware vSphere Enterprise Plus for 1 processor for 2 Months Vmware
2	VDI-PRE-100-GOV	VMware View Premier Bundle:100 Pack, including VI Enterprise, View Manager, View Composer, ThinApp (Packager, Client, WS) and VC Server licensed for 100 desktop VMs-Tier 3
2	VDI-PRE-100-3P-SSS-GOV	Platinum Support/Subscription for VMware View Premier Bundle:100 Pack for 3 years

Conclusion

The Tarrant Regional Water District VDI deployment has been a work in progress for several years. The IT staff at TRWD has "grown up" with desktop virtualization technology, and gained valuable experience along the way. While limitations and inherent complexities of early VDI solutions prevented TRWD from initially meeting its project requirements, persistence has paid off. The combination of Unidesk and VMware View on HP hardware is enabling TRWD to significantly reduce the operational costs of desktop management, accelerate delivery of new applications, provide employees anywhere/anytime access to desktops, streamline the on-boarding of consultants, reduce energy use on endpoint devices, and improve the quality of service that TRWD delivers to Tarrant County residents and communities.

Last updated: March 23, 2012